DOCUMENT RESUME

ED 174 642 TM 009 264

AUTHOR Strasler, Gregg M.
TITLE The Process of Transfer in a Learning for Mastery Setting.
PUB DATE Apr 79
NOTE 25p.; Paper presented at the Annual Meeting of the American Educational Research Association (63rd, San Francisco, California, April 8-12, 1979)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *Academic Aptitude; Achievement Gains; Classroom Research; Junior High Schools; Learning Activities; *Learning Processes; Learning Theories; *Mastery Learning; *Skill Development; *Study Skills; *Transfer of Training

ABSTRACT

The purpose of this study was to investigate two types of transfer of learning (application transfer and gains in aptitude) in a mastery learning instructional mode. Seventh grade students were assigned either to a learning for mastery instructional mode or to a control group in a conventional classroom. Although the content matter covered and time alotted for learning were the same for all students, the students who received mastery learning instruction appeared to benefit from being oriented to the process of mastery learning. In contrast, students who received conventional lecture-based instruction displayed no noticeable improvement with respect to applicational transfer or gains in aptitude. Consequently, a learning strategy utilized in teaching students the process of learning how to learn enhanced not only the immediate effect of applicational transfer, but the slower-acting effects of gains in aptitude as well. (RD)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED174642

U S DEPARTMENT OF HEALTH,
EDUCATION & WELFARE
NATIONAL INSTITUTE OF
EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY

The Process of Transfer in a Learning for Mastery Setting

Gregg M. Strasler

South Carolina Region V Educational Services Center

Abstract

The purpose of this study was to investigate two types of transfer of learning defined by Cronbach (1963) in a "learning for mastery" (Bloom, 1968) instructional mode: applicational transfer and gains in aptitude. Cronbach states that the most significant type of transfer may be the increased ability to learn in a particular field. In an experimental study involving 93 seventh grade students, one such strategy for learning how to learn appears to be inherent in a learning for mastery setting.

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

Gregg M. Strasler

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC) AND USERS OF THE ERIC SYSTEM."

A paper presented at the annual meeting of the American Educational Research Association, San Francisco, 1979.

TM009 264

The Process of Transfer in a Learning for Mastery Setting

Gregg M. Strasler

South Carolina Region V Educational Services Center

Introduction

Knowledge is expanding exponentially in modern society. In a world of computers and scientific inquiry, man is becoming less and less able to keep up with his expanding knowledge and technology. Schools are less adept at imparting this wealth of knowledge to their students than ever before. Therefore, a more realistic approach may be for the schools to teach various strategies for learning, that is, strategies that are applicable in a wide variety of learning situations. In other words, students may profit more from schooling if we attempt to teach students to learn how to learn or to teach students general learning sets. In essence, it appears that one of the important goals of schooling should be to teach strategies for learning that can be transferred to learning situations both inside and outside the school environment.

Although the concept of transfer has been repeatedly addressed by educators as one of the important goals of schooling, this learning criterion has received little attention in the form of school-based educational research. In fact, Brownell (1948) stated that transfer is the one classical learning criterion that is used least frequently in evaluating the impact of instructional strategies on student learning. Brownell emphasizes the concept of transfer as a vital concern in education despite the fact that probably not 10 percent of educational investigations give recognition to the criterion.

Theoretical Framework of Transfer of Learning

Transfer of learning. The concept of transfer of learning has been repeatedly addressed by educators as one of the important goals of schooling. The study of transfer is the study of the effects of earlier learnings upon the acquisition of later learning tasks. In essence, the broad area of transfer of learning may be defined as the ability to apply past learning to either the solution of new problems or to the facilitation of new learning. The fact that transfer occurs has long been recognized. Controversial opinions exist in regard to the explanation of how it occurs and how best to ensure maximum transfer benefits.

The review of the literature indicates numerous views have been postulated on the subject of transfer of learning. Historically, these views on transfer have been categorized under the general theories of formal discipline (Morgan, 1906), identical elements (Thorndike and Woodworth, 1901), and generalizability (Judd, 1908). However, the theories of formal discipline and identical elements have been largely discredited with respect to learning in school-based settings. The literature supports the theory of generalizability (i.e., an understanding of a theoretical principle underlying an experience contributes to transfer) as well as the notion that one acquires learning sets ("learning to learn") in the learning process (Harlow, 1949).

In conceptualizing transfer of learning within the context of a school-based environment, Cronbach (1963) reasons that there are but two types of transfer arranged on a continuum of immediacy of effect. Cronbach states that the main objective in current curricula appears to be to develop aptitude[1] for mastering new materials in the field. In his discussion, Cronbach mentions there are two types of transfer that are arranged on a continuum of immediacy of effect: the more immediate pole is labelled "applicational transfer" while the slower-acting effects are labelled as "gains in aptitude" (cf. Ferguson, 1954).

Cronbach notes that nearly all educational research on transfer has tested immediate performance on a partly-new task (i.e., "applicational transfer"). Simply stated, students are taught to solve equations in "x," and a test includes equations stated in "y" or "z." For example, a teacher describes an experimental study in a psychology text and asks the student to discuss possible interpretations and needed controls. Cronbach stresses, however, that the more significant type of transfer may be the increased ability to learn in a particular field (i.e., "gains in aptitude"). The student who masters a general science course may become better able to comprehend certain types of principles and procedures, so that he gains more from a subsequent year of study in physics. Cronbach states that in spite of the difficulties in attempting to measure the effect of a course on an individual's subsequent learning, such "learning to learn" is so vital that serious efforts should be made to detect such effects and to understand how they may be developed.

Transfer of learning and mastery learning. In their initial chapter, Block and Anderson (1975) noted that there appear to be a number of possible student learning outcomes inherent in the mastery learning approach to school learning. Under the category of intellectual outcomes, they included the area of transfer of learning: the ability to apply past learning to either the solution of new problems or to the facilitation of new learning. This definition closely parallels that of Cronbach's(1963) "applicational transfer" and "gains in aptitude," respectively.

In essence, the mastery learning instructional procedure is derived largely from the work of Dollard and Miller (1950) concerning learning theory (Anderson, 1973a). Dollard and Miller propose that there are four factors essential to learning: drive, cue, response, and reward. The drive stimulus impels responses which are usually guided by cues from other stimuli not strong enough to act as drives but more specifically distinctive than the drive. If some one response is followed by reward, the connection between the stimulus pattern and this response is strengthened, so that the next time that the same drive and other cues are present, this response is more likely to occur.

In the mastery learning model, the teacher provides cues to the students concerning what they are to learn and how they are to learn it. The students become active participants in the learning process. After the students have spent a certain amount of time in active learning, they are given a test covering the objectives and content that they were supposed to learn. If they attain the mastery level, they receive reinforcement from knowing they succeeded.

---

[1]Cronbach (1971) defines aptitude as: "a complex of personal characteristics that accounts for an individual's end state after a particular educational treatment, i.e., that determines what he learns, how much he learns, or how rapidly he learns" (p. 139).

If they do not attain the mastery level, they receive procedures by which they can correct their inadequacies.

Mastery learning (Bloom, 1968) attempts to accommodate individual differences among learners to promote the fullest development of each learner through a set of stated instructional goals. Instruction is individualized within the context of regular group instruction by means of on-going, specific feedback about each student's learning progress, coupled with a variety of corrective instructional modes to help the pupil learn material unmastered during group instruction.

The mastery learning model appears to incorporate the four factors (drive, cue, response, reward) Dollard and Miller suggest are essential to learning. The utilization of these factors in the mastery learning model provides a learning environment in which students should be able to learn how to learn. Given the process of the mastery learning approach, students should become more adept at applying past learning to either the solution of new problems or to the facilitation of new learning.

Block (1974, pp. 42-50) reviewed the literature done on transfer and mastery learning. He found nine studies that hint at the impact that mastery learning strategies might have on either the student's ability to apply the skills achieved under one set of conditions to his solution of new problems or to his learning of related, new material.

The studies reviewed by Block give some evidence that learning for mastery strategies do tend to foster transfer of learning effects. Block, however, admits most of the evidence is based on speculation. It is important to note that the main purpose of each of the above studies was not to study the effect of transfer of learning per se. However, with the exception of one study (Anderson, 1973b), these studies would be classified under Cronbach's definition of applicational transfer (i.e., the ability to apply past learning to the solution of new problems) since they primarily were involved with learning over sequential units of instruction. Cronbach's gains in aptitude (i.e., learning to learn; the ability to apply past learning to the facilitation of new learning) has not been adequately addressed in mastery learning research.

In conclusion, most of the studies in mastery learning can be labelled as the "Does it work?"or "Type 1" mastery learning research (Block & Burns, 1976). In an exhaustive review of the basic ideas and practices as well as the associated research on mastery learning, Block and Burns (1976) state that all of the Type 1 studies used common school-learning criterion measures (Brownell, 1948) and, in particular, measures of student achievement and retention. Block and Burns did not focus on the impact of mastery strategies on student transfer measures, since all but two of the transfer studies they reviewed (Block, 1972; Ware, 1976) used grades in a subsequent nonmastery taught course as their measure of transfer and Ware (1976) failed to employ a nonmastery experimental treatment. Block and Burns note that the learning-to-learn effects of mastery strategies fall under their category of "Type 2" mastery learning research: "If it works, then what might follow?" As stated by Block and Burns, this literature is extremely diverse and highly speculative. More research needs to be done under the Type 2 category.

Summary of Experimental Study and Results

Experimental study. The sample consisted of 93 seventh grade students selected from two junior high schools (three classes per school) located in a southeastern metropolitan area. These schools were selected so that they were as similar as possible with regard to size, location, etc.

The experimental study involved a total of 93 seventh grade students for 23 class days of instruction in two mini-courses (ecology and geometry). Of the total number of students, 47 students in three classes were assigned to a "learning for mastery" (Bloom, 1968) instructional mode and the remaining 46 students in three other classes served as a control. Although both instructional modes were based on the same objectives and content for each unit of instruction, the learning for mastery students received immediate feedback and corrective procedures for each one of the three "learning exercises" (formative tests) administered in the ecology and geometry mini-courses. The learning for mastery students also received additional time in the classroom in the form of small group (four to five students per group) discussion. These small group discussions, led by ninth grade honor students, were designed to help the students with any problems they had on the learning exercises. The students assigned to the control group received the same number of tests (labelled "quizzes") but differed from the learning for mastery students in that there was no feedback or corrective procedures nor any small group discussions. Instead, the control students received supplemental worksheets which they were required to work on individually.

The major question posed in this study asks whether the process of transfer ("learning to learn") is more evident for students in a learning for mastery setting than for students in a more conventional classroom setting. If there is a mastery learning strategy involved in teaching students to learn how to learn, it would seem plausible to study the process of transfer in mastery learning over nonsequential mini-courses as well as over sequential units of instruction. As related to the present study, will the increased ability to learn in one mini-course (i.e., ecology) be carried over or transferred to another mini-course (i.e., geometry) that is not directly sequential in nature?

Results. In an effort to make this section more readable, the means and standard deviations of the unit achivement measures for the mastery and non-mastery learning students are presented in Table 1. The hypotheses and results specific to each hypothesis follow.

Table 1
Means and Standard Deviations of Unit Achievement Measures for Mastery Learning and Nonmastery Learning Students

	Mastery Learning Students		Nonmastery Learning Students	
Test Type	N	Mean (SD)	N	Mean (SD)
	Science (Ecology) Mini-course			
Summative Pretest				
Total Group	47	6.81 (2.59)	46	6.57 (2.09)
Class 1	10	7.10 (2.56)	15	6.87 (1.81)
Class 2	18	7.61 (2.57)	21	6.71 (2.22)
Class 3	19	5.90 (2.45)	10	5.80 (2.25)
Learning Exercise 1				
Total Group	47	9.49 (3.67)	46	8.54 (2.61)
Class 1	10	9.70 (3.89)	15	7.93 (2.46)
Class 2	18	10.83 (2.66)	21	8.57 (2.69)
Class 3	19	8.11 (4.03)	10	9.40 (2.63)
Learning Exercise 2				
Total Group	47	11.02 (3.56)	46	8.78 (2.91)
Class 1	10	8.80 (2.74)	15	7.60 (3.04)
Class 2	18	13.72 (2.19)	21	9.24 (2.91)
Class 3	19	9.63 (3.47)	10	9.60 (2.32)
Learning Exercise 3				
Total Group	47	11.79 (4.03)	46	9.57 (3.37)
Class 1	10	10.00 (3.92)	15	8.87 (2.42)
Class 2	18	13.78 (3.06)	21	10.19 (3.36)
Class 3	19	10.84 (4.27)	10	9.30 (4.57)
Summative Posttest				
Total Group	47	13.28 (3.71)	46	9.44 (3.46)
Class 1	10	12.00 (4.19)	15	7.60 (2.50)
Class 2	18	15.00 (2.93)	21	10.52 (3.28)
Class 3	19	12.32 (3.65)	10	9.90 (4.18)

Table 1 (continued)
Means and Standard Deviations of Unit Achievement Measures
for Mastery Learning and Nonmastery Learning Students

	Mastery Learning Students		Nonmastery Learning Students	
Test Type	N	Mean (SD)	N	(Mean (SD)
	Mathematics (Geometry) Mini-course			
Summative Pretest				
Total Group	47	6.66 (2.97)	46	4.57 (1.95)
Class 1	10	5.70 (2.45)	15	4.00 (1.60)
Class 2	18	7.67 (3.60)	21	4.52 (2.18)
Class 3	19	6.21 (2.37)	10	5.50 (1.72)
Learning Exercise 1				
Total Group	47	10.57 (3.93)	46	8.07 (2.97)
Class 1	10	8.70 (4.00)	15	6.33 (2.35)
Class 2	18	12.83 (2.18)	21	9.33 (2.82)
Class 3	19	9.42 (4.30)	10	8.00 (3.02)
Learning Exercise 2				
Total Group	47	9.00 (2.49	46	7.02 (1.94)
Class 1	10	8.30 (1.95)	15	6.60 (1.84)
Class 2	18	10.22 (2.76)	21	7.48 (2.02)
Class 3	19	8.21 (2.10)	10	6.70 (1.89)
Learning Exercise 3				
Total Group	47	10.62 (3.17)	46	8.24 (2.69)
Class 1	10	8.60 (2.01)	15	6.87 (2.20)
Class 2	18	11.94 (3.08)	21	9.10 (3.02)
Class 3	19	10.42 (3.25)	10	8.50 (1.90)
Summative Posttest				
Total Group	47	11.66 (4.18)	46	7.22 (2.71)
Class 1	10	10.80 (3.12)	15	6.40 (2.06)
Class 2	18	14.11 (3.43)	21	8.10 (2.63)
Class 3	19	9.79 (4.30)	10	6.60 (3.37)

H_1: Students in mastery learning instruction will achieve higher achievement scores over sequential units of instruction than students in nonmastery instruction.

The first hypothesis (H_1) addresses Cronbach's (1963) concept of "applicational transfer" in the measurement of student learning outcomes. This hypothesis is investigated by examining the unit achievement measures (learning exercises 1-3 and the summative posttest) of the mastery and nonmastery groups in the ecology and geometry mini-courses. The means and standard deviations of these unit achievement measures for the two treatment groups are presented in Table 1. These results are portrayed graphically in Figures 1a and 1b, respectively.

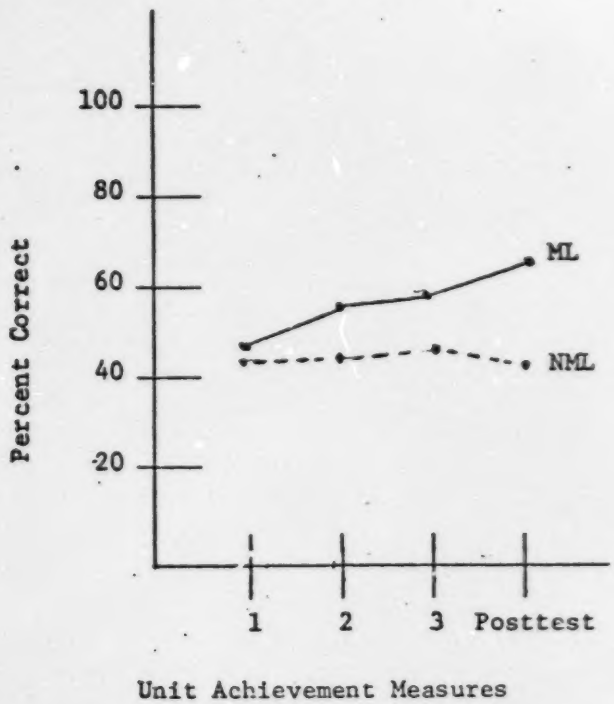

Figure 1a. Percent correct of unit achievement measures (learning exercises 1-3, posttest) of mastery learning (ML) and nonmastery learning (NML) groups in the ecology mini-course.

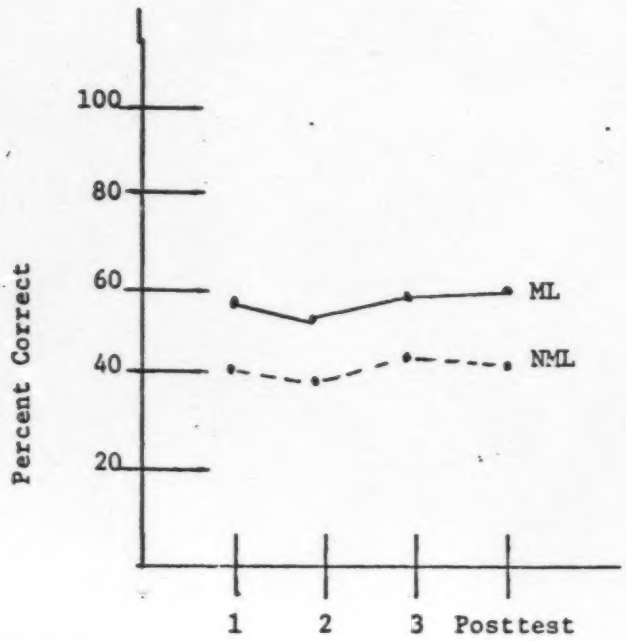

Figure 1b. Percent correct of unit achievement measures (learning exercises 1-3, posttest) of mastery learning (ML) and nonmastery learning (NML) groups in the geometry mini-course.

The results of the ANOVA procedures for the ecology and geometry mini-courses are presented in Tables 3 and 4, respectively.

Table 3
Analysis of Variance for Ecology Unit Achievement Measures

Source of Variation	DF	SS	F-value
Dependent Variable: Summative Pretest			
Group	1	1.38	.26(ns)
Class (Group)	4	35.99	1.67(ns)
Within Cells	87	468.59	
Dependent Variable: Learning Exercise 1			
Group	1	20.80	2.15(ns)
Class (Group)	4	82.29	2.13(ns)
Within Cells	87	840.87	
Dependent Variable: Learning Exercise 2			
Group	1	116.51	14.21***
Class (Group)	4	249.36	7.60***
Within Cells	87	713.44	
Dependent Variable: Learning Exercise 3			
Group	1	114.78	8.91**
Class (Group)	4	136.47	2.65*
Within Cells	87	1120.71	
Dependent Variable: Summative Posttest			
Group	1	343.12	29.74***
Class (Group)	4	164.87	3.57**
Within Cells	87	1003.84	

Table 4
Analysis of Variance for Geometry Unit
Achievement Measures

Source of Variation	DF	SS	F-value
Dependent Variable: Summative Pretest			
Group	1	101.97	16.64***
Class (Group)	4	44.86	1.83(ns)
Within Cells	87	533.00	
Dependent Variable: Learning Exercise 1			
Group	1	146.37	14.55***
Class (Group)	4	231.06	5.74***
Within Cells	87	875.23	
Dependent Variable: Learning Exercise 2			
Group	1	90.99	19.63***
Class (Group)	4	51.67	2.79*
Within Cells	87	403.31	
Dependent Variable: Learning Exercise 3			
Group	1	131.45	17.07***
Class (Group)	4	117.46	3.81**
Within Cells	87		
Dependent Variable: Summative Posttest			
Group	1	458.74	43.36***
Class (Group)	4	212.03	5.01***
Within Cells	87	920.35	

In the first mini-course (ecology), there was no significant difference between the two treatment groups on the first learning exercise. This result would be expected because both groups were taught in essentially the same manner (the learning for mastery students received no feedback or corrective procedures nor participated in any small group discussions prior to this unit achievement measure). However, in learning exercises 2 and 3 and on the summative posttest, the mastery learning students scored significantly higher than the nonmastery learning students ($p < .01$).

Similarly, in the second mini-course (geometry), learning for mastery students significantly outperformed ($p < .001$) the nonmastery group on all unit achievement measures (learning exercises 1 through 3 and the summative posttest).

Table 5 presents z-values depicting average achievement of the two groups in the ecology and geometry mini-courses.

Table 5
Z-values to Express the Difference in Average Achievement between Mastery Learning and Nonmastery Learning Groups in the Ecology and Geometry Mini-courses

Test Type	Ecology Mini-course	Geometry Mini-course
Learning Exercise 1	.30	.66
Learning Exercise 2	.65	.81
Learning Exercise 3	.58	.63
Summative Posttest	.95	1.07

Note. Z-values were used as ratios to express the differences in average achievement test scores (learning exercises 1-3) between the two groups in the standard deviation unit of the total group of 93 students (i.e., $z = \bar{X}_{ML} - \bar{X}_{NML}/SD$ total).

The z-values in Table 5 are ratios expressing the difference in average achievement test scores between the two groups in the standard deviation unit of the total group of students. The difference in mean scores between the mastery learning and nonmastery learning groups (in favor of the learning for mastery students) tends to widen over the unit achievement measures (with the exception of learning exercise 3) as the students progress through the sequential instructional unit in each mini-course. This difference in mean scores is most apparent in the summative posttest of each mini-course. Since the units of instruction in each mini-course were sequential in nature and the posttests were representative measures of the instructional units covered, the learning for mastery students seem to be more able than nonmastery students to apply past learning to the solution of new problems (i.e., applicational transfer).

The unit achievement measures (tests) were composed of six knowledge, seven comprehension and seven application and/or analysis items as defined by Bloom's taxonomy - (Bloom, et al., 1956). The means and standard deviations of the summative test item classifications (i.e., knowledge, comprehension, and application and/or analysis items) for the treatment groups are presented in Table 6. The results of the ANOVA procedures for the ecology and geometry mini-courses are presented in Tables 7 and 8, respectively. Discussion of the data presented follows.

Table 6
Means and Standard Deviations of Summative Test Item Classifications for Mastery Learning and Nonmastery Learning Students

	Mastery Learning Students		Nonmastery Learning Students	
Item Classification	N	Mean (SD)	N	Mean (SD)
Summative Pretest (Ecology)				
Knowledge				
Total Group	47	2.34 (1.29)	46	2.07 (1.00)
Class 1	10	2.30 (1.42)	15	2.00 (.76)
Class 2	18	2.44 (1.04)	21	2.10 (.77)
Class 3	19	2.26 (1.49)	10	2.10 (1.66)
Comprehension				
Total Group	47	2.21 (1.27)	46	2.22 (1.19)
Class 1	10	2.50 (1.08)	15	2.73 (1.22)
Class 2	18	2.44 (1.34)	21	2.29 (1.10)
Class 3	19	1.84 (1.26)	10	1.30 (.82)
Application and/or Analysis				
Total Group	47	2.26 (1.19)	46	2.28 (1.13)
Class 1	10	2.30 (1.06)	15	2.13 (.99)
Class 2	18	2.72 (1.41)	21	2.33 (1.32)
Class 3	19	1.79 (.86)	10	2.40 (.97)
Summative Posttest (Ecology)				
Knowledge				
Total Group	47	4.17 (1.31)	46	3.33 (1.27)
Class 1	10	3.80 (1.48)	15	2.53 (1.19)
Class 2	18	4.17 (1.10)	21	3.71 (1.01)
Class 3	19	4.37 (1.42)	10	3.70 (1.42)
Comprehension				
Total Group	47	4.96 (1.71)	46	3.54 (1.62)
Class 1	10	4.10 (1.73)	15	2.87 (1.25)
Class 2	18	5.89 (1.37)	21	4.33 (1.43)
Class 3	19	4.53 (1.65)	10	2.90 (1.85)

Table 6 (continued)
Means and Standard Deviations of Summative Test Item Classifications for Mastery Learning and Nonmastery Learning Students

	Mastery Learning Students		Nonmastery Learning Students	
Item Classification	N	Mean (SD)	N	Mean (SD)
Summative Posttest (Ecology) Continued				
Application and/or Analysis				
Total Group	47	4.15 (1.56)	46	2.57 (1.60)
Class 1	10	4.10 (1.60)	15	2.20 (1.61)
Class 2	18	4.94 (1.16)	21	2.48 (1.33)
Class 3	19	3.42 (1.58)	10	3.30 (2.00)
Summative Pretest (Geometry)				
Knowledge				
Total Group	47	2.83 (1.27)	46	2.00 (1.03)
Class 1	10	2.40 (1.27)	15	2.00 (.93)
Class 2	18	3.00 (1.33)	21	2.00 (1.18)
Class 3	19	2.90 (1.24)	10	2.00 (.94)
Comprehension				
Total Group	47	2.34 (1.31)	46	1.33 (1.03)
Class 1	10	2.20 (1.23)	15	1.07 (.88)
Class 2	18	2.83 (1.54)	21	1.38 (1.07)
Class 3	19	1.95 (.97)	10	1.60 (1.17)
Application and/or Analysis				
Total Group	47	4.15 (1.56)	46	2.57 (1.60)
Class 1	10	1.10 (.74)	15	.93 (.88)
Class 2	18	1.83 (1.25)	21	1.14 (1.06)
Class 3	19	1.37 (1.46)	10	1.90 (1.37)

Table 6 (continued)
Means and Standard Deviations of Summative Test Item Classifications for Mastery Learning and Nonmastery Learning Students

	Mastery Learning Students		Nonmastery Learning Students	
Item Classification	N	Mean (SD)	N	Mean (SD)
		Summative Posttest (Geometry)		
Knowledge				
Total Group	47	4.17 (1.34)	46	2.96 (1.54)
Class 1	10	4.20 (1.55)	15	2.53 (1.64)
Class 2	18	4.56 (1.20)	21	3.24 (1.51)
Class 3	19	3.79 (1.32)	10	3.00 (1.49)
Comprehension				
Total Group	47	4.34 (1.74)	46	2.80 (1.49)
Class 1	10	4.20 (1.23)	15	2.47 (1.36)
Class 2	18	5.39 (1.15)	21	3.48 (1.21)
Class 3	19	3.42 (1.92)	10	1.90 (1.66)
Application and/or Analysis				
Total Group	47	3.15 (1.83)	46	1.46 (1.07)
Class 1	10	2.40 (1.17)	15	1.40 (1.06)
Class 2	18	4.17 (1.76)	21	1.38 (.87)
Class 3	19	2.58 (1.81)	10	1.70 (1.49)

Note. The number of items in each item classification for the summative tests was as follows: Knowledge (6 items); Comprehension (7 items); Application and/or Analysis (7 items).

Table 7
Analysis of Variance of Summative Test Item Classifications for Ecology Mini-course

Source of Variation	DF	SS	F-Value
Summative Pretest			
Dependent Variable: Knowledge Items			
Group	1	1.76	1.27(ns)
Class (Group)	4	.42	.08(ns)
Within Cells	87	120.94	
Dependent Variable: Comprehension Items			
Group	1	.0.	.0. (ns)
Class (Group)	4	16.91	3.05*
Within Cells	87	120.79	
Dependent Variable: Application and/or Analysis Items			
Group	1	.02	.01(ns)
Class (Group)	4	8.59	1.64(ns)
Within Cells	87	113.67	
Summative Posttest			
Dependent Variable: Knowledge Items			
Group	1	16.57	10.70***
Class (Group)	4	16.12	2.60*
Within Cells	87	134.64	
Dependent Variable: Comprehension Items			
Group	1	46.48	20.15***
Class (Group)	4	50.61	5.49***
Within Cells	87	200.72	
Dependent Variable: Application and/or Analysis Items			
Group	1	58.31	25.59***
Class (Group)	4	29.05	3.19*
Within Cells	87	198.21	

Table 8
Analysis of Variance of Summative Test Item Classifications for Geometry Mini-course

Source of Variation	DF	SS	F-Value
Summative Pretest			
Dependent Variable: Knowledge Items			
Group	1	16.01	11.59***
Class (Group)	4	2.45	.44(ns)
Within Cells	87	120.19	
Dependent Variable: Comprehension Items			
Group	1	23.92	17.74***
Class (Group)	4	9.33	1.73(ns)
Within Cells	87	117.33	
Dependent Variable: Application and/or Analysis Items			
Group	1	1.46	1.05(ns)
Class (Group)	4	9.89	1.79(ns)
Within Cells	87	120.23	
Summative Posttest			
Dependent Variable: Knowledge Items			
Group	1	34.24	16.48***
Class (Group)	4	9.81	1.18(ns)
Within Cells	87	180.75	
Dependent Variable: Comprehension Items			
Group	1	54.85	26.17***
Class (Group)	4	55.41	6.61***
Within Cells	87	182.38	
Dependent Variable: Application and/or Analysis Items			
Group	1	66.59	33.26***
Class (Group)	4	31.19	3.89**
Within Cells	87	174.18	

With respect to the first hypothesis (applicational transfer), Tables 7 and 8 indicate that the mastery learning students significantly outperformed ($p < .001$) the nonmastery learning students on the ecology and geometry summative posttests in all three item classifications (i.e., knowledge, comprehension, and application and/or analysis items). In addition, F-values progressively increased from knowledge to comprehension to application and/or analysis items on the summative posttests in both mini-courses. Although there were significant differences ($p < .001$) in favor of the mastery learning students on the knowledge and comprehension item classifications of the geometry summative pretest, no significant differences are noted between treatment groups in the item classifications of the ecology summative pretest nor in the application and/or analysis items of the geometry summative pretest. In essence, the mastery learning students appear to have increased their ability to apply past learning to the solution of new problems (as measured by summative posttest performance on application and/or analysis items). Based on the results presented, the first hypothesis appears to be supported by the data.

H_2: Students in mastery learning instruction will achieve higher achievement scores on the initial unit of a subsequent nonsequential set of instructional units than students in nonmastery instruction.

Cronbach's (1963) concept of "gains in aptitude" is addressed in the second hypothesis (H_2). This hypothesis is investigated by observing the performance of the mastery and nonmastery groups on the first learning exercise in each of the two nonsequential sets of instructional units (i.e., the ecology and geometry mini-courses). As noted in the investigation of the first hypothesis (see Table 3), there is no significant difference between the two groups on learning exercise 1 in the first mini-course (ecology). As reasoned in presenting the first hypothesis, this result is plausible because both groups are taught in a similar manner to this point in the instructional sequence.

However, as shown in Table 4, the learning for mastery students significantly outperformed ($F=14.55$, $p < .001$) the nonmastery students on learning exercise 1 in the second mini-course (geometry). Since both groups are exposed to the same subject matter in equal time frames to this point in the instructional sequence and since the treatment groups are quite similar with respect to verbal and nonverbal ability, the significant difference in mean scores between groups on learning exercise 1 of the geometry mini-course appears to substantiate the notion of such "gains in aptitude" for the mastery learning group. Figure 2 graphically represents this phenomenon.

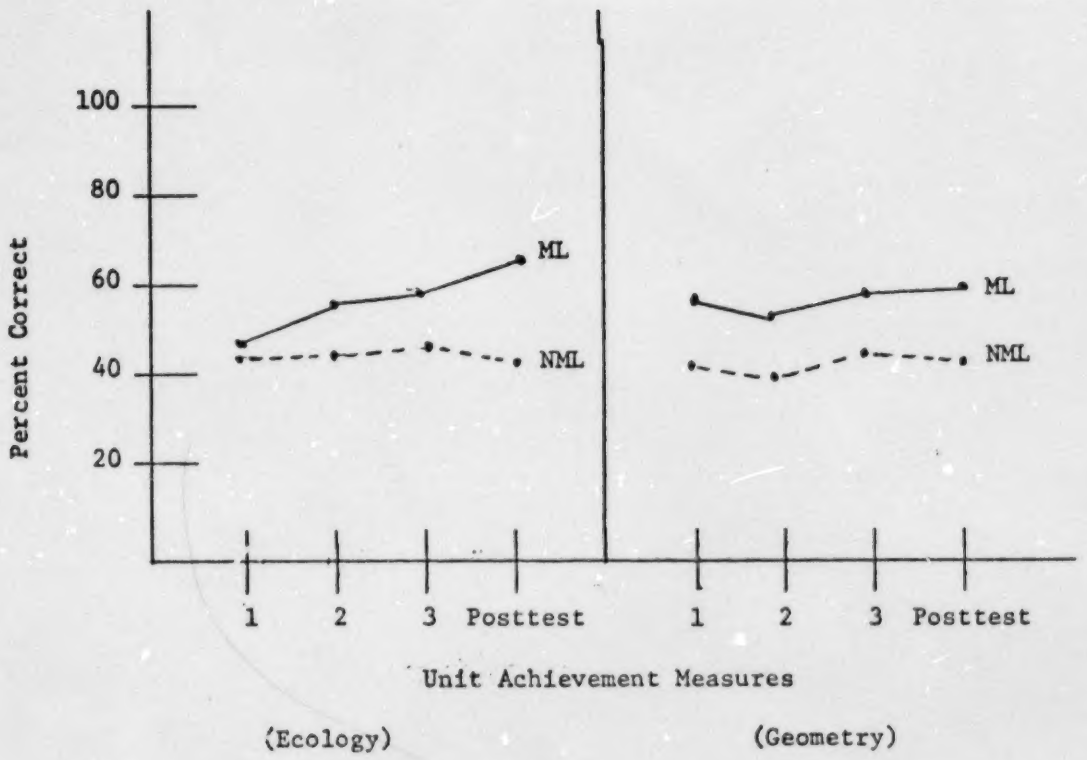

Figure 2. Percent correct of unit achievement measures (learning exercises 1-3, posttest) of mastery learning (ML) and nonmastery learning (NML) groups over nonsequential mini-courses.

Using a ratio to express the difference in average achievement test scores between the two groups in the standard deviation unit of the total group of students (see Table 5), the learning for mastery students were only three-tenths of a standard deviation (z=.30) better than the nonmastery students on learning exercise 1 in the ecology mini-course compared to a superior seven-tenths of a standard deviation (z=.68) on learning exercise 1 in the geometry mini-course (the nonsequential set of instructional units).

Although the learning for mastery students received no feedback or corrective procedures nor participated in any small group discussions prior to the first learning exercise in either mini-course, they significantly outperformed the nonmastery students on learning exercise 1 of the nonsequential geometry mini-course. The learning for mastery students appear to be more able to apply past learning to the facilitation of new learning (i.e., gains in aptitude); however, the results are confounded somewhat by the fact that the mastery learning students scored significantly higher than the nonmastery learning students on the geometry summative pretest.[1]

---

[1]The mastery learning and nonmastery learning students were found to be statistically equivalent on three student entry behaviors (the verbal and nonlanguage subtests of the CTMM and the summative pretest in ecology) in the present study prior to instruction. However, the geometry summative pretest was actually administered during the experimental study rather than prior to it. Therefore, the effect of the study itself may have caused the noted difference.

As mentioned in the presentation of the results in the first hypothesis (applicational transfer), the mastery learning students significantly outperformed the nonmastery learning students on the ecology and geometry summative posttests with regard to knowledge, comprehension, and application and/or analysis items (see Tables 7 and 8). As can be seen in Tables 7 and 8, the transfer across the two mini-courses is confined to the knowledge and comprehension type items. This observation may be construed as lending support to Jensen's (1956) discussion of an "attitude for transferability."[2]

On the other hand, a case can be made in support of Cronbach's (1963) notion of "gains in aptitude" in that the transfer with the geometry mini-course was in the area of the application and/or analysis items. In essence, the results of the study are clear, but the reason for the results may either be due to an "attitude for transferability," "gains in aptitude," or some combination of the two phenomena. On the basis of this discussion, the second hypothesis appears (with reservation) to be supported by the data.

Conclusions and Implications

A major conclusion derived from the experimental study involves the student learning outcome of transfer of learning. Given the process of the mastery learning approach, students in mastery learning instruction appear to be more adept at applying past learning to either the solution of new problems (applicational transfer) or to the facilitation of new learning (gains in aptitude) than students in nonmastery instruction.

Although the content matter covered and time allotted for learning were precisely the same for all students in the present study, the students who received mastery learning instruction appeared to benefit from being oriented to the process of the learning for mastery approach. In contrast, students who received conventional lecture-based instruction without a specific process for learning displayed no noticeable improvement with respect to applicational transfer or gains in aptitude. Consequently, a learning strategy utilized in teaching students the process of learning how to learn enhances not only the immediate effect of applicational transfer but the slower-acting effects of gains in aptitude as well.

A major implication of this study may be derived from the finding that students in mastery learning instruction appear to be more adept at applying past learning to either the solution of new problems (applicational transfer) or to the facilitation of new learning (gains in aptitude) than students in nonmastery instruction. Students in mastery learning instruction achieved both significantly higher achievement scores over sequential units of instruction

---

[2]If the mastery learning students had developed the process of "learning to learn" during the ecology mini-course, for example, these same students may have developed an "attitude for transferability" (cf. Jensen, 1956) -- that is, the realization that learning has transfer value. If these students had developed such an attitude, it is conceivable they would have tried harder than the nonmastery learning students to do well on the geometry summative pretest.

(ecology and geometry mini-courses) as well as on a subsequent nonsequential unit of instruction (learning exercise 1, geometry mini-course) than students in nonmastery instruction.

In the present study, the mastery learning students received "concept sheets" which defined the terms, facts, concepts, and rules and principles to be learned at the beginning of each instructional unit. These terms and facts were used as building blocks for the conceptualization of concepts and rules and principles within each of the instructional units. A test-feedback-retest procedure was used to help students attain a criterion level of 80% correct on each formative test before moving on to the next sequential instructional unit. In essence, the process of the mastery learning approach enabled students in mastery learning instruction to develop strategies in learning how to learn.

Schools should be teaching students various strategies for learning. The strategies a student develops for learning in school should enable him to function effectively in particular learning situations both within and outside school. One of the important goals of schooling should be the teaching of strategies of learning that are transferable to learning situations within and outside the school environment. As mentioned previously, Cronbach (1963) states that the most significant type of transfer may be the increased ability to learn in a particular field. One such strategy for learning how to learn appears to be inherent in a learning for mastery setting.

References

Anderson, L. W. Mastery learning: An overview. Paper presented at Andrews University, 1973. (a)

Anderson, L. W. Time and school learning. Unpublished doctoral dissertation, University of Chicago, 1973. (b)

Block, J. H. Schools, society, and mastery learning. New York: Holt, Rinehart, & Winston, 1974.

Block, J. H. Student learning and the setting of mastery performance standards. Educational Horizons, 1972, 50, 183-191.

Block, J. H., & Anderson, L. W. Mastery learning in classroom instruction. New York: Macmillan, 1975.

Block, J. H., & Burns, R. B. Mastery learning. In L. S. Shulman (Ed.), Review of research in education (Vol. 4). Itasca, Ill.: Peacock, 1976.

Bloom, B. S. Learning for mastery. Evaluation Comment, 1968, 1 (2), 1-12.

Bloom, B. S., Englehart, M. D., Furst, E. J., Hill, W. H., & Krathwohl, D. R. Taxonomy of educational objectives: Handbook I: Cognitive domain. New York: David McKay, 1956.

Brownell, W. A. Criteria of learning in educational research. Journal of Educational Psychology, 1948, 39, 170-182.

Cronbach, L. J. Course improvement through evaluation. Teachers College Record, 1963, 64, 672-683.

Cronbach, L. J. How can instruction be adapted to individual differences? In M. D. Merrill (Ed.), Instructional design: Readings. Englewood Cliffs, N. J.: Prentice-Hall, 1971.

Dollard, J., & Miller, N. E. Personality and psychotherapy. New York: McGraw-Hill, 1950.

Ferguson, G. A. On learning and human ability. Canadian Journal of Psychology, 1954, 8, 95-112.

Harlow, H. F. The formulation of learning sets. Psychological Review, 1949, 56, 51-65.

Jensen, B. T. What about transfer? Peabody Journal of Education, 1956, 34, 71-77.

Judd, C. H. The relation of special training to general intelligence. Educational Review, 1908, 36, 28-42.

Morgan, C. L. Psychology for teachers. New York: Scribner, 1906.

Thorndike, E. L., & Woodworth, R. S. The influence of improvement in one mental function upon the efficiency of other functions. Psychological Review, 1901, 8, 247-261, 384-395, 553-564.

Ware, A. A comparison of two mastery learning strategies for teaching geographic concepts. Unpublished doctoral dissertation, University of Washington, 1976.